DESCRIPTION

PLASMA DISPLAY PANEL WITH SUPERIOR LIGHT-EMITTING CHARACTERISTICS, AND METHOD AND APPARATUS FOR PRODUCING THE PLASMA DISPLAY PANEL

FIELD OF THE INVENTION

This invention relates to a plasma display panel used as a display for a color television receiver or the like, and also relates to a method of producing the plasma display panel.

BACKGROUND OF THE INVENTION

Recently, Plasma Display Panel (PDP) has received attention as a large-scale, thin, lightweight display for use in computers and televisions, and the demand for high-definition PDPs has also increased. Document EP0554172A1 discloses a conventional, typical technique related to a construction and production method of PDP.

FIG. 29 is a sectional view showing a general AC-type PDP.

In the drawing, a front glass substrate 101 is covered by a stack of display electrodes 102, a dielectric glass layer 103, and a dielectric protecting layer 104 in the order, where the dielectric protecting layer 104 is made of magnesium oxide

(MgO) (see, for example, Japanese Laid-Open Patent Application No.5-342991.

baking the applied silver paste. The partition walls 107 are formed by applying the glass paste to the surface of the layers in stripes with a certain pitch, and baking the applied glass paste. The fluorescent substance layers 110 to 112 are formed by applying fluorescent substance pastes of each color to the space between the partition walls, and baking the applied pastes at around 500℃ to remove resin and other elements from the pastes. Japanese Laid-Open Patent Application No.2-08834 discloses a technique for forming a fluorescent substance film by applying a fluorescent substance slurry then drying the applied slurry by high-temperature dry air.

After the fluorescent substances are baked, a sealing glass frit is applied to an outer region of the back glass substrate 105, then the applied sealing glass frit is baked at around 350℃ to remove resin and other elements from the applied sealing glass frit. (Frit Temporary Baking Process)

The front glass substrate 101 and the back glass substrate 105 are then put together so that the display electrodes 102 are perpendicular to the address electrodes 106, the electrodes 102 facing the electrodes 106. The substrates are then bonded by heating them to a temperature (around 450℃) higher than the softening point of the sealing glass. (Bonding Process)

The bonded panel is heated to around 350℃ while gases are exhausted from inner space between the substrates (space

formed between the front and back substrates, where the fluorescent substances are in contact with the space) (Exhausting Process). After the exhausting process is

completed, the discharge gas is supplied to the inner space to a certain pressure (typically, in a range of 300Torr to 500Torr).

A problem of the PDP manufactured as above is how to improve the luminance and other light-emitting characteristics.

To solve the problem, the fluorescent substances themselves have been improved. However, it is desired that the light-emitting characteristics of PDPs are further improved.

A number of PDPs are increasingly manufactured using the above-described manufacturing method. However, the production cost of PDPs is considerably higher than that of CRTs. As a result, another problem of the PDP is to reduce the production cost.

One of many possible solutions to reduce the cost is to reduce efforts taken (time required for work) and the energy consumed in several processes that require heating processes.

DISCLOSURE OF THE INVENTION

It is therefore an object of the present invention to provide a PDP which has high light-emitting efficiency and superior color reproduction. It is another object of the present invention to provide a PDP production method in which the temporary baking, bonding, and exhausting processes are performed in shorter work time, with lower energy consumption so

that the production cost is reduced.

The above first object is achieved by improving the chromaticity of light emitted from blue fluorescent substance layers. This is achieved by setting the chromaticity coordinate y (the CIE color specification) of light to 0.07 or less or the peak wavelength of a spectrum of light to 453nm or less when vacuum ultraviolet rays are radiated onto the blue cells to excite the blue fluorescent substances.

Such an improvement in the chromaticity of light emitted from blue fluorescent substance layers as described above increases the color temperature of light (white balance) when the light is emitted from all the cells, and improves the color reproduction.

The above PDP having a superior chromaticity of light emitted from blue fluorescent substance layers is produced by performing the bonding process while steam vapor is forced to exhaust from the inner space by, for example, circulating a dry gas in the inner space.

The above PDP is also produced by performing a preparative heating step before the bonding process, where in the preparative heating step, a front panel and a back panel are heated in an atmosphere of dry gas while a space is opened between the sides of the panels facing each other. Alternatively, the above PDP is produced by performing a heating step before the bonding process, where in the heating step, a

panel is heated while an MgO layer formed on the panel is in contact with a dry gas.

The above improvement is achieved by the production method of the present invention since it prevents blue fluorescent substances from being degraded by heat by reducing the amount of water preserved in the inner space. In contrast, in a conventional PDP production method, the blue fluorescent substances are degraded by heat of water emitted into the inner space in the bonding process, resulting in degradation of the light-emitting intensity and the chromaticity of emitted light.

The above PDP whose blue fluorescent substance layers emit light with a superior chromaticity is also produced by performing the bonding process, after a while heating the bonded panels to a certain temperature while circulating a dry gas in the inner space, and starting an exhausting step.

With the above construction, even if the chromaticity of light emitted from the blue fluorescent substance layers is degraded by heat of the water in the bonding process, the chromaticity is recovered since the water is removed from the inner space as the dry gas is circulated in the inner space while the bonded panels are heated to the certain temperature.

Here, the "dry gas" indicates a gas containing steam vapor with lower partial pressure than the typical partial pressure. It is preferable to use an air processed to be dried

(dry air).

It is desirable that the partial pressure of the steam vapor in the dry gas atmosphere is set to 15Torr or less, more preferably to 10Torr or less, 5Torr or less, 1Torr or less, 0.1Torr or less. It is desirable that the dew-point temperature of the dry gas is set to 20℃ or lower, more preferably to 10℃ or lower, 0℃ or lower, -20℃ or lower, -40℃ or lower.

The above PDP with improved chromaticity of light emitted from blue fluorescent substance layers is also manufactured by a PDP production method in which: the front and

back panels are temporarily baked while a space is opened between their facing sides; the front and back panels are bonded while a dry gas is circulated in an inner space between the panels; or the front and back panels are bonded together after preparatively heated while a space is opened between their facing sides.

The second object of the present invention is achieved by: a method in which after the front panel and the back panel are bonded together by a sealing material in between by maintaining a bonding temperature, the exhausting process is started while the panels are not cooled from the bonding temperature to room temperature, and gases are exhausted from the inner space between the panels; or a method in which after the front panel and the back panel with a sealing material in between are temporarily baked by maintaining a temporary bonding temperature, then the bonding process is started while the panels are not cooled from the temporary bonding temperature to room temperature.

In the actual manufacturing procedure, each of such heating processes is performed using a heating furnace. Conventionally, the sealing material temporary baking process, the bonding process, and the exhausting process are separately performed, and the panels are cooled to room temperature at each interval between processes. With such a construction, it requires a long time and consumes much energy for the panels to